IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 10, Issue 2, Ver. II (Mar - Apr.2015), PP 07-09
www.iosrjournals.org

Remote Readout of Radiation Using Wireless Communication

Rashmi Adatkar[1], Nisha Makwana[2], Nandini Mane[3], Rahul Kumar[4]
Department of Electronics and Telecommunication
K.J. Somaiya Institute Of Engineering And Information Technology
Sion (E), Mumbai 400022, India

Abstract: *In this paper, a solution of remote background radiation monitoring, based on the concept of Wireless Sensor Network (WSN), is presented. Radiation dose rate measured by the sensor node is sent to the monitoring station through ZigBee wireless network operated on 2.4 GHz unlicensed Industrial Scientific Medical (ISM) band. Power consumption of the sensor node is kept low by operating the node ZigBee radio with low duty cycle: i.e by keeping the radio awake only during data transmission/reception. Two ATmega8 microcontrollers are programmed to perform interfacing, data processing, and control functions. Range of coverage of the system is extendable via the use of ZigBee router(s).*
Keywords: *Zigbee, Wireless sensor network, Radiation monitoring using GM counter, Application of Zigbee.*

I. Introduction

The project mainly focuses on detecting and measuring radiations. Gieger-muller(GM) counter is used to detect the radiations. The project mainly consists of two units namely: A radiation monitoring unit and second is read out unit. Radiation monitor instrument basically consists of radiation detector which will detect various radiation like X-rays and gamma rays. GM counter produces output in the form of pulses. These pulses will in the form of spikes mixed with the noise signals. To remove the noise the output is passed through various blocks following the output of properly shaped rectangular pulses with noise interference. The pulses will be counted and transmitted wirelessly though zigbee to readout unit. These registered counts will be displayed on 16 digit two line LCD display.

II. Purpose Of The Project

Ionizing Radiation plays many roles integral to the existence of life. However, it can be, and has been demonstrated to be, dangerous to biological systems [1]. A number of events have occurred throughout history in which people have been exposed to dangerous amounts of radiation in their living and occupational environments. These adverse effects of ionizing radiation in humans are the important considerations underlying the development of safe radiation exposure limits; 0.5µSv/h for the general public and 27µSv/h for radiation workers [2]. The monitoring of the environment background radiation will hasten the detection of heightened radiation activity in good time for prompt response[4].

III. Current Situation

Many of the radiation monitoring systems are wired systems. Hence the cost of wiring, maintenance and repairing cost also automatically increases. Also the path through which data travels is specific or decided. Hence if any problem occurs in the path then there is no other path for data transmission. Hence the system is not ideal in case of radiation monitoring. So a system with multiple paths and with proper data transmission has to be developed. Hence a wireless system is better in solving the above problems. As in wireless medium, cost for transmitter and receiver has to be considered and we get infinite paths while data transmission. Hence a zigbee based radiation monitoring system will be developed.

IV. Circuit Discription

1. Hardware Components

Power supply, microcontroller at89c51, GM counter, Pulse Shaper And Comparator, Zigbee unit, Oriole LCD display.

2. Software Components

Keil software, Protel.

V. Block Diagram

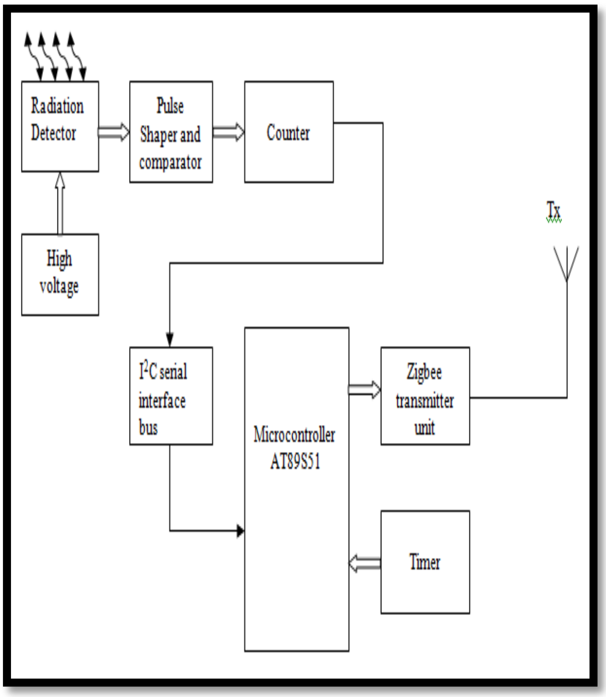

Fig no.1 Monitoring unit to detect radiation

In monitoring unit the first block is GM detector block. A sufficiently high voltage is applied to GM counter which detects the radiation and produces the output in the form of variable pulses. These pulses contain the required radiation level and the noise pulses. To remove the noise pulses further the output is passed through the pulse shaper and comparator block. In pulse shaper and comparator block a threshold level is set so that only those pulses whose levels are higher than the threshold level are passed and the remaining noise pulses are attenuated. The pulse shaper shapes these pulses to produce proper rectangular pulses. Now the output of this block is will be the required rectangular output pulse. The next block is counter which counts the number of pulses, the number of pulses corresponds to the level of radiation, the higher the number of pulses the higher is the radiation. This count is given to microcontroller AT89C51 for transmitting it to display unit. An external variable timer is also interfaced which gives the time period for which the radiation should be measured. In Zigbee unit the count value is modulated with 4.3GHz frequency using OQPSK modulation. The count is then wirelessly transmitted to the readout unit.

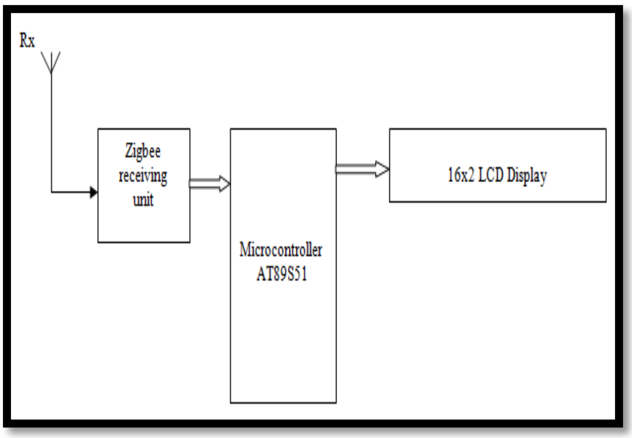

Fig no.2 Readout unit to display measured radiation

The range of Zigbee unit is about 100-300m. Hence the readout unit can be placed anywhere within the range. The first block in the readout unit is the second Zigbee unit which is now acting as a receiver. It receives the modulated signal sent by the first unit and demodulates it. Now the demodulated output i.e the count value which is maximum of 16 bit in size is given to the port 0 and port 1 of second microcontroller. A LCD is interfaced to the microcontroller to port 2 which can be used for displaying the count. Hence the value corresponds to the level of radiation.

VI. Conclusion

The Wireless Background Radiation Monitoring System was tested at a radioactive waste storage facility and the test confirmed its suitability for continuous monitoring, as results obtained from the system only show deviation within +/-4% of those obtained using a certified radiation measuring device . The system range of coverage obtained for both outdoor (line of sight) and indoor application can be extended by the introduction of ZigBee router node(s) between the two units, in multi-hop peer to-peer topology. The depth of this extension can be up to the 32 network hops allowable in ZigBee Pro wireless network.

Reference

[1]. Jaworowski Zbigniew, "Radiation Risks and Ethics". Physics Today, Volume 52, Issue 9, pp. 24 – 29, 1999

[2]. Tsoulafanidis N. (1983), "Measurement and Detection of Radiation". Hemisphere Publishing Corporation New York, pp. 486-487, 1983.

[3]. http://www.americas.fujielectric.com/sites/default/files/Fuji%20Electric%20Radiation%20Dept%20%20Remote%20Monitoring%20Technology_1.pdf

[4]. Ding Fei, Guangming Song, Kaijian Yin, Jianqing Li and Aiguo Song (2009), "A GPS Enabled Wireless Sensor Network for Monitoring Radioactive Materials". Sensor and Actuators A 155, Elsevier Publications, pp. 210-215, 2009